ENTOMOLOGICAL
SOCIETY OF
BRITISH COLUMBIA

PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY

OF

BRITISH COLUMBIA

(INCORPORATED)

OCTOBER, 1923

NUMBERS SEVENTEEN AND NINETEEN

ECONOMIC SERIES

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Evans & Hastings, 578 Seymour Street, Vancouver, B. C.

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PROCEEDINGS

OF THE

British Columbia Entomological Society

The Twenty-second Annual Meeting was held in the Court House, Vancouver, on Saturday the 17th of February, 1923.

The President, Mr. L. E. Marmont, was in the chair, and from twelve to fifteen members were present throughout the meeting.

At the business session in the morning, three new members were proposed and accepted, Mr. K. F. Auden, Mr. A. O. Hope, and Mr. O. Whittaker.

A redraft of the by-laws was passed upon for incorporation purposes.

It was decided not to provide another cup this year for school competition.

Upon the motion of Mr. Venables, it was decided to hold a summer meeting at Vernon during the visit of the Dominion Entomologist.

The following papers were read:—

Presidential Address.....L. E. Marmont
Collecting in the Sagebrush of the Southern Okanagan Valley†.....E. R. Buckell
Key to the Vespini†.....C. D. Garrett
Control of Oyster-shell Scale with Oil Sprays†.....M. H. Ruhmann
The Peach Twig Borer in B. C.†.....R. C. Treherne
Economic Entomology in the Dry Belt.....E. P. Venables
Notes on Economic Insects in 1922.....W. Downes
New Records of B. C. Hemiptera.....W. Downes
Effect of Fumigation on Certain Insects.....W. H. Lyne
The Elm-Currant Aphis.....R. Glendenning
Forest Entomology†.....R. Hopping
Mosquito Control at Banff†.....E. Hearle
Relation of Botany to Entomology†.....W. B. Anderson

Slides showing the beauties of the Mymaridae were shown under the microscope by Mr. Whittaker.

†Read by proxy.

The election of officers for 1923 resulted as follows:—

Honorary President.....F. Kermode
President.....L. E. Marmont
Vice-President (for Coast).....R. S. Sherman
" (for Interior).....M. H. Ruhmann
Advisory Board:
The Officers, and J. Davidson, W. Downes, E. Hearle, W. H. Lyne, and E. P. Venables.
Honorary Secretary-Treasurer.....R. Glendenning, Agassiz, B. C.
Hon. Auditor.....W. S. Moore, J.P.

It was decided, according to precedent, to hold the 1924 meeting in Victoria, B. C.

REPORTS OF THE SECRETARY-TREASURER, 1922

I beg to submit a report on the following subjects:—

Finances,

Publication of Proceedings,

Catalogue of Library,

Incorporation,

The Society's Cup and the Encouragement of Entomology in Schools, and

Membership.

The **Finances** are tolerably satisfactory. After spending just over $300 on printing, we have in hand $73 and no liabilities. This sum, with the usual Provincial grant which we have been promised, will place us comfortably off, if not in affluence, during 1923.

Publication of Proceedings

Only one number of our Proceedings was published this year. This, No. 20, consisted of two valuable systematic papers, the report and our President's address.

There has been keen demand for this number, and I think we have enhanced the value of our Proceedings by its publication.

Catalogue of Library

It has been found impossible to get anyone to undertake this task, consequently our members are still quite in the dark regarding what books are available for borrowing. It had been decided to distribute mimeographed copies of the list to members.

Incorporation

The by-laws, a declaration, the consent of the Ontario Society, all duly signed and witnessed, were with considerable trouble gotten to-

gether and submitted to the Registrar, only to be returned on account of our by-laws as revised and adopted at our last meeting not conforming to the requirements of the act.

The cost will be approximately $25, and, should you still wish to become incorporated, it will be necessary for us to revise our by-laws to-day and provide for the $25 in our next year's expenditure.

ENCOURAGEMENT OF ENTOMOLOGY IN SCHOOLS

This subject has been approached from two directions; firstly, by giving a cup for an exhibit of insects; and, secondly, by co-operating with and endeavouring to render assistance and advice to the Director of Elementary Agricultural Education, Mr. Gibson.

With regard to the latter, the Advisory Board, to whom the matter was referred at our last meeting, have suggsted certain methods for use in schools, and have endorsed Mr. Gibson's idea of short circulars for instruction purposes.

The offering of a cup, which cost over $50, has, I am sorry to say, met with no adequate response in the matter of encouraging Entomology in the schools of the Province, and the cup has now passed out of the Society's possession, being won thrice by the John Norquay School, South Vancouver.

MEMBERSHIP

This now stands at 32 fully paid-up members. This is a decrease of about 10, and, while this is to be regretted, the greater number of those retiring were not active members.

As secretary, I regret the growing apathy of the old brigade of amateur systematists, which has been increasingly noticeable during the past year.

R. GLENDENNING,
Hon. Sec.-Treas.

PRESIDENTIAL ADDRESS

To the Members of the British Columbia
Entomological Society:

Gentlemen,—

I have much pleasure in welcoming you to the 22nd Annual Meeting of the Society.

The past year has not been marked by any unusual or outstanding event or feature pertaining to the progress of the Society, but I may say that we have maintained our position financially and otherwise satisfactorily, and enter another year with a fairly good cash balance, and this in spite of the fact that the printing of our proceedings, which has hitherto been done gratis by the Government, had to be met out of our own funds.

The membership has, I believe, been kept up to its usual standard, but has not made the advance we should all have liked to see. I hope, at this meeting, to see some scheme formulated or some good suggestions advanced which will tend to bring about this desirable result, for we must get more members, if we are to continue as a live organization and carry on the work properly pertaining to such an organization.

With this object in view, you will remember that the Society donated a handsome cup, to be competed for by the public schools of the Province, to become the property of the school exhibiting the best collectin of B. C. insects, of not less than four orders, and winning the cup three times in succession. This was done by the John Norquay School of South Vancouver, and the cup passed into their possession. Unfortunately, by omitting the condition that the collection shown must be bona-fide the work of the scholars, this school was able to become the possessors of the cup by exhibiting a good collection donated to the school by a kind friend, and thus the object of the Society was defeated. Under the wording of the conditions as set forth in the Fair prize list, there was no alternative but to award the cup, as to do otherwise would be breaking faith with the exhibitors. If at any time the Society should offer another prize, they will doubtless benefit by this experience and make the conditions in keeping with the object aimed at.

The secretary informs me that there have been numerous requests from many quarters for some of our economic papers, showing that the work of our energetic members is being recognized as very valuable to economic and applied Entomology, and while we all feel that this is as it should be, and the utmost value must rightly be attached to these most important matters, let us try at the same time to so popularize the study of insects as to enlist the interest of what we may call the ordinary layman who would not bother to read highly technical papers, and would not understand them if he did. There are many persons, and especially the younger ones, who only require a little encouragement to become keen students of nature, and a proportion of these develop into real entomologists.

I would also like to see a little more co-operation among our present members, but perhaps this is rather difficult where they are so widely scattered over so large a Province, but at any rate there should be nothing to prevent them sending in papers or even notes of interest to be read at the annual meetings.

During the year, good work has been done by many of the members in extending our knowledge of the insect fauna of the Pacific Province.

The tent caterpillar outbreak which began some three or four years ago shows signs of abating, and I am of the opinion that the effects of the widely spread forest fires of the past summer on this pest will be noticeable.

The European Satin Moth is spreading in the Lower Mainland, especially in the district round New Westminster, and in this connection I have observed a sort of change in their food habits. An outbreak in Maillardville began in 1921 on Lombardy poplar. Near these were three large Russian Poplar trees which were not affected in 1921. In 1922 (last year), by the end of June, the Russian Poplars were completely stripped of leaves, and the caterpillars were massed along the bare limbs, while the Lombardy Poplars nearby were almost untouched. The owner cut off all the limbs and the tops of the Russian Poplars, the caterpillars then swarmed on to his house in masses, and were played upon by fire hose under good pressure, afterwards dying and drying up in thousands. Plenty of them, however, pupated, and enough moths emerged to do damage next season.

I might record among my captures last season a beautiful, newly emerged specimen of the rare moth **Aemilia roseata**, on July 2nd, and in September of a specimen of **Papaipema insulidens**. The season, on the whole, however, was not particularly good for collecting.

In conclusion, I would express the hope that our deliberations at this annual meeting may result in much benefit to the Society.

Yours,

L. E. MARMONT.

THE EUROPEAN EARWIG IN BRITISH COLUMBIA

By R. C. Treherne, Entomological Branch,
Dominion Department of Agriculture.

In his book on the "Orthoptera of North-Eastern America," W. S. Blatchley states that "about 400 species of earwigs have been described, mostly from tropical and semi-tropical countries, where they are common along the sea-coast. Many of the species are cosmopolitan in distribution, their form enabling them to hide readily in the crevices of ships and their cargoes, and thus be borne to all parts of the earth. Inland they are scarce, especially in temperate and cold regions. Only fifteen native or established species of earwigs are at present known from America, north of Mexico."

Canada, until a few years ago, only possessed one species, **Labia minor Linn**, an introduction from Europe originally, which had been taken from several widely separated points throughout the Dominion. This species, commonly known as the "Little Earwig" and so called from its length, which is only 4-5 mm., is recorded from Quebec, Ottawa, Manitoba and Salmon Arm, B. C.

We have now to record a second species for Canada in **Forficula auricularia Linn**, the so-called European Earwig. Thus far the Coast cities of Vancouver and New Westminster are the only points in Canada known

to be infested, and there is a strong possibility that Victoria may also harbour the pest. This species is also European in origin and cosmopolitan. From its habits it bids fair to become a pest of some importance in places where it finds conditions suitable to its reproduction. It is described by Blatchley as follows: "Dark reddish-brown; basal joints of antennae, sides of pronotum, hind margins of abdominal segments, forceps and legs paler; tegmina and wings dull yellow. Tegmina one-half longer than pronotum. Forceps of male about as long as abdomen, their legs flattened and broadened at base, then usually curved almost into a semi-circle, armed on the inner side at base with a large quadrate crenulate tooth, and another at beginning of curve; legs of female forceps slightly curved, crenulate on inner margin and crossing at tips. Length of body 10-12 mm.; of tegmina, 2 mm.; of forceps, male 4-7 mm.; female 3 mm."

The first specimens of **F. auricularia** actually reported for British Columbia were taken alive by the author in September, 1916, at Vancouver, in the hold of the SS. Talthybius, on arrival from Europe and Asia. This was adventive material of a kind that undoubtedly had been imported in the holds of trans-Pacific vessels for many years. Comstock, in his 1901 Manual of Insects, refers to this insect on the Pacific Coast, and Morgan Hebard records a note by Fieber in Lotos 3, 254, 1853, as adventive American material. This insect, however, was not long to remain in the holds of vessels alone. In 1912 a male and a female were captured at Newport, Rhode Island, in the New England States of America. In August, 1919, reports of the presence of this insect were received from the neighborhood of English Bay, in the city of Vancouver, and in 1920 the reports increased in numbers. An examination revealed the fact that the insects were widespread through the "west end" of the city and in Stanley Park. In 1921, specimens were seen on the foliage of trees in the boulevards of Vancouver and New Westminster. The numbers found undoubtedly indicated an earlier introduction than 1919. Curiously enough reports of the presence of this insect arrived almost simultaneously at many coast cities in America, following the Newport introduction in 1912. In 1914, Kingston, R.I., announced its presence; Seattle in 1915; East Aurora, New York State, in 1917. One observation has led to others, and it is doubtless probable that search will reveal these insects at many seaport towns not now recorded as infested.

The avenues of introduction are numerous. In addition to the direct importation through merchandise at the ports, these insects have been taken in nursery stock, bulbs and plants imported from Europe.

For instance, T. I. Beaulue captured some specimens in Holland nursery stock at Montreal in the autumn of 1914, and T. D. Cockerell found adults in Dutch tulips imported into Boulder, Colorado, in 1918. E. R. Sasscer observed them in the soils around imported florist stock in the eastern United States.

These insects are well-known pests in Europe and Australia, where they cause material damage to flowers and vegetables in the gardens by feeding upon tender green shoots. The petals and stamens of ornamental flowers are freely devoured and roses frequently suffer. They are also carnivorous in that they destroy sluggish larvae in the soil, feed upon dead animal matter and upon the dead and dying of their own species.

They are more objectionable in houses where, being mainly nocturnal in habits, they secrete themselves in upholstery, under cushions, rugs, in verandah awnings and in every conceivable place to avoid light or noise.

As to their life habits, it is supposed that only the females survive the winter, their eggs being deposited in the autumn in garden soil. Young larvae make their appearance in the spring (April and May), feeding by night on grass and plants at soil surface. They usually become full-grown in mid July and in late summer, congregating in great numbers in crevices around houses for mating purposes. The adults may also find their way into houses, where their presence is a source of considerable worry to housewives, not so much from their injurious habits as their unpleasant natures.

In control, sodium fluoride mixed in equal parts with flour sprinkled in houses where the insects are common will appreciably diminish their number. In gardens, in soil adjoining houses, the use of naphthaline, soot or lime, applied in autumn, will in some measure deter them in their converging habits. In the open garden, poison baits for the larvae may be used in May and June. Paris green and stale bread, 1 part to 16 parts by weight, mixed with water, is fairly satisfactory. The bread, which is broken up into fine particles, and the poison should be mixed dry and water added to make a mixture, which, when broadcasted over the lawn or garden, will break up into small particles. This is the control measure recommended by D. W. Jones of the U.S. Department of Agriculture. Three applications over ten days are suggested, warm evenings being chosen for the operations.

B. B. Fulton, of the Oregon Experimental Station, used wheat bran, 1 gallon; sodium fluoride, 6 ounces, and molasses ½ pint, with enough water to moisten. This is broadcasted over the garden at dusk, as with the other bait, and the formula given is considered sufficient for an ordinary city lot.

These baits are applied against the young larvae feeding on the soil surface, and advantage is taken of the carnivorous habits of both larvae and adults.

In England, inverted flower pots filled up with straw or hay are used as traps for the adults. Being night feeders, they hide during the daytime, and advantage is taken of this habit to entice the adults to traps which may be examined and the contents destroyed daily.

THE RELATION OF THE PREDATORY MITE "HEMISARCOPTES MALUS" Shimer TO THE OYSTER-SHELL SCALE IN BRITISH COLUMBIA

BY E. P. VENABLES, ENTOMOLOGICAL LABORATORY, VERNON, B. C.

The careful researches of Dr. J. D. Tothill upon the distribution and habits of this mite within the Dominion are recorded in Vol. 9 of the Bulletin of Entomological Research for 1919.

We find that during the year 1916-1917 samples of scale-infested wood were received by him from all the Provinces within the Dominion, and were examined for the presence of this predatory mite; whilst occurring in all the fruit-growing sections east of the Rocky Mountains, the mite was, for some reason, absent from the material sent in from British Columbia. The samples from this Province were taken in the following localities: Kaslo, Grand Forks, Vernon, Lillooet, Agassiz, Harrison, Nicomen, North Vancouver, Kuper Island, Victoria, Alberni, and Duncan.

As regards the presence of the mite within the North American Continent, it is known to occur in Nova Scotia, New Brunswick, Quebec, Prince Edward Island, Ontario, Massachusetts, Ohio, Illinois, and Iowa. No examples were secured from the Prairie Provinces, this being probably due to the absence of suitable food plants for the Oyster shell scale.

From the very high destruction wrought by this mite among the eggs of the scale in certain of these localities, reaching in some cases as high as 90-95%, it became apparent that the introduction of the **Hemisarcoptes** into the Province of British Columbia was a matter of some moment, and to achieve this result the following method was employed:

Consignments of scale-infested twigs harbouring the mite were secured from New Brunswick in 1917, and were placed upon trees infested with Oyster Shell Scale at various points in the Province of British Columbia as follows: Royal Oak (Brydon Farm), Mission (near Catchpole Farm), at Agassiz Experimental Farm, and at South Vernon. The twigs as received were tied upon trees to be used as centres of distribution; these included Hawthorne, Red Osier Dogwood, and Apple trees, the Dogwood being found to be a very favourite food plant attacked by the scale.

The trees selected for the liberation of the mite in the Vernon district were situated some two miles from the city, and were growing on a piece of waste land on the banks of the Vernon creek. These trees, three in number, had been very heavily infested with the scale for some years, and were growing in close proximity to the native timber fringing the

creek banks, much of which was coated with scale, more especially the Red Osier Dogwood. In the Spring of 1920, these trees were carefully gone over for the purpose of ascertaining whether the mite had become established, cuttings being taken and the scale examined under the binocular. These investigations revealed the fact that the **Hemisarcoptes** was numerous, and that many eggs had been destroyed. At the same time the native vegetation was gone over to some extent and the mite discovered some 200 yards distant from the point of liberation in 1917.

In the Spring of 1921, a more extended search was undertaken, and as a result the mites have been found to be quite numerous at a distance of one and a-half miles from the originally infected trees. In this district the mite was, as far as obsevations have been carried out, almost entirely confined to the native vegetation along the creek banks; this may be due to the fact that the trees infected in 1917 were isolated by at least one-half mile of open country on one side before the nearest apple trees were encountered, and upon the other by a belt of willows, and various indigenous trees which follow the course of the creek. All the cultivated orchards lay beyond the creek on that side.

The accompanying chart shows the distribution of the **Hemisarcoptes** in this locality, and gives some idea of the condition already referred to. In order to carry the infection to districts somewhat distant from the points of recovery, in 1921, scale-infested twigs were taken in the south Vernon area from trees known to harbour mites, and were placed upon trees at the Coldstream; apple and dogwood were used in all these cases for the introduction of the mite. In all, nineteen separate infections were made during the spring and summer of 1920-21, the same procedure being followed as in the original transference carried out in 1917.

THE HABITS AND APPEARANCE OF HEMISARCOPTES MALUS

In order that the relation of the **Hemisarcoptes** to the Oyster shell scale may be clearly comprehended, a brief summary of the life history of the latter insect is advisable. Much of the following account is taken from the paper of Dr. J. D. Tothill, already referred to.

In the Okanagan the eggs of the scale hatch approximately during the end of May, or early in June, dependent upon climatic conditions. The newly hatched nymphs, after wandering around for a few hours, settle down and insert their mouth parts in the bark, in which position the insect remains fixed for the remainder of its existence; the scaly covering, which consists of the moulted skins of the individual being gradually enlarged until maturity is reached, which, in the Okanagan Valley, will be some time in late July, or early August, and at that time the eggs of the scale insect will be found to have made their appearance. These eggs remain beneath the parent scale until the following May or June, a period of ten or eleven months, and during practically the whole of that period the predatory mites have undisturbed access to them.

In looking over specimens of the Oyster shell scale in search of examples of the **Hemisarcoptes**, there will be found no external evidence of their presence, but, on the scale being inverted, the appearance of the eggs, if attacked, is quite characteristic. Even if no mites are found, a number of empty eggshells being in evidence with a certain percentage of injured eggs of a shrivelled appearance lying in confusion, the mites being found amongst these, and also scattered amongst the undamaged eggs.

The mites are shining white in colour, and are approximately of the same size as the eggs of the scale insect. The body is oval in outline; the legs, eight in number, are provided with "tarsal suckers," which are of service to the creature in walking over slippery surfaces; there will be found arising from the hind tarsi a number of long hairs, which are dragged along by the mite in its wanderings; these hairs are evidently of of some service to the mite in enabling it to find a foothold, the hairs being closely applied to the surface upon which the mite is resting, even an inverted plate of glass appearing to offer no obstacle to their progress. It is a well-known fact that this mite is never to be found beneath old, empty scales, but is always discovered in the presence of healthy eggs, or under those scales harbouring the parent female, for it appears, from the observations of Ewing, Webster, and A. R. Baird (Tothill, l. c. p. 194), that the **Hemisarcoptes** feeds also upon the parent scales themselves. From the above facts, and also from the appearance of the mite when compared with certain species of scavenger mites, also found in association with the oyster shell scale, the matter of identification is not a difficult one. The number of mites to be found beneath a single scale varied, in those examples examined at Vernon, from a single adult to six or seven individuals, both adults and young nymphs; the latter being provided with only six legs, mature specimens possess eight in all. The eggs of this mite are deposited beneath the caudal margin of the scale, and occurred in numbers varying from six to fourteen in those cases noted at Vernon. Individual eggs are somewhat less than half the size than the eggs of the scale insect, shining white in colour and oval in outline.

The maximum period of oviposition of this mite appears from local observations to be during April and May, although eggs have been found during the entire summer. Lignieres, in his observations on the oviposition of the mite in France, states that eggs were found at all seasons of the year, the minimum number being found from November to January. Ewing and Webster, in their Iowa observations recorded in "Psyche, Volume XIX., No. 4," noted a similar set of conditions to the above, finding eggs and mites numerous beneath the scales on March 29th, and also during April and May.

Local notes at Vernon are quite incomplete as regards the period of oviposition; no eggs were found during March, the first eggs noted being on April 14th.

It has been frequently observed, in examining scales for the presence of this mite, that the only indication of its work will be a cluster of eggs lying just beneath the caudal margin of the scale, the parent that deposited them having evidently moved off to some other location. The number of eggs laid by a single female does not appear to be known, but, from information gleaned during the work with the mite at Vernon, it would appear that individual females deposited a few eggs beneath a number of scales, as the eggs when found varied in numbers from half a dozen to fifteen or twenty. Between May 7th and 18th, 119 scales were examined for the presence of the mite, these scales being taken from various localities in the mite-infested area; it was found that mites were present beneath 22 of them, six individuals being the greatest number seen beneath a single scale. The fact that this mite feeds upon the San Jose Scale has been well established. Mr. Dearness, in 1899, received samples of this scale from Kent County, Ontario, and found numbers of the mite feeding upon the mature female scale insects, as many as eighteen larval mites being observed beneath a single scale.

Various other species of mites will be encountered beneath the empty scales of the oyster shell scale; among these may be noted two species known to occur in British Columbia, **Tydeus gloveri**, a gregarious species, which may be found to the number of 15 or 20 beneath a single scale; this species is recognizable by the median line on the abdomen.

A species of **Gamasus** will also be found hibernating beneath the empty scales; this is a fairly large mite, possessing two conspicuous whitish markings extending almost the whole length of the body.

INSECTS OF ECONOMIC IMPORTANCE IN THE FRASER VALLEY IN 1921

BY R. GLENDENNING, ENTOMOLOGICAL LABORATORY, AGASSIZ, B. C.

On several occasions in the past ten years, since the resuscitation of the Society, members have given papers dealing in a general way with insect conditions during that year in the various districts that they happened to be located in.

These may be found in the Proceedings under such titles as: "Report from Vancouver," "Report from Okanagan District," "Insects of the Lower Fraser Valley," etc., etc., and have been contributed by such respected members of our Society as the late Messrs. Thos. Cunningham and Tom Wilson, Messrs. Treherne, Ruhman, Venables, Brittain, and others. These papers, with the Reviews of Applied Entomology contributed from time to time by Mr. Treherne, while possibly of only passing interest at the time, will undoubtedly form a very valuable history of Economic Entomology in this Province, their value increasing with age.

The year 1921 was marked by no great insect outbreak on the Lower Mainland. Even the mosquito crop failed to materialize, and the chief trouble was from the insidious attentions of our usual pests. Looking back over our previous papers covering this district, I find about thirty-five chief pests mentioned, and while I will not touch at length on all of these, it will be interesting for future comparison to mention their scarcity or abundance.

Vegetable Insects

The Imported Cabbage Worm (**Pieris rapae L**).—This was plentiful this year and took its usual toll of cruciferous vegetables. It is surprising that an insect so easily controlled is allowed to do so much damage. A remedy that appeals to me always, from its simplicity, is the lime-arsenate dusting. Lime (twenty pounds), and lead arsenate powder (one pound), dusted on the leaves when wet with dew in the early morning.

The Cabbage Root Maggot (**Hylemyia brassicae Bouche**).—This insect was also very abundant this year, and there is now no reason for growers to take a loss with the 100% immunity obtained by the mercury bi-chloride treatment—1 ounce to 10 gallons in three treatments.

Cutworms.—With the exception of the variegated cutworm (**Lycophotia margaritosa Haw**), but little damage from these insects came to my notice. The above exception was, however, plentiful in August in various points in the Valley, and one record of damage was received from Golden, in the Columbia Valley. No parasites were recovered from material reared and collected at Agassiz; we therefore may possibly have an epidemic next year, as was the case in 1900 and 1905. Tomatoes were the chief crop affected, and the climbing habit of this species was demonstrated on this host, the fruits being eaten right to the top of the plant.

Some damage to mangolds and beets was reported from Lulu Island in June from cutworms, but the species was not ascertained.

Slugs.—Although not insects technically, entomologists are usually consulted regarding these troublesome mollusks, which this year were unusually abundant in the Fraser Valley. The usual remedies were apparently insufficient to check them, and much damage was done, especially to young corn, which in some instances had to be replanted.

Liming on **three** consecutive nights is, I am told, a certain remedy. Bordeaux mixture is also strongly recommended by workers in Oregon as being highly distasteful to slugs.

Flea Beetles.—Cabbage, turnips, hops and potatoes all suffered this year from these pests, which are not easy to control during the summer. The hop yards rely chiefly on clearing up the hibernating places as a control measure.

SHADE TREE INSECTS

Antique Tussock Moth (**Notolophus badia**).—The moths were quite abundant in Vancouver this fall. No damage, however, was noticed this summer from the feeding larvae, although I frequently came across them on poplars when on Satin moth studies. Mr. Bush recorded an epidemic in 1911.

Tent Caterpillars (**Malacosoma disstria erosa Hbn and M. pluvialis Dyar**).—These two species reached their maximum last year, and this year a slight decline was noticed; parasites, both egg and larval, being frequently noted. Wilt diseases, however, so common in the two previous years, were not noted this summer. These insects are again appearing at points up the Fraser Valley, where for several years they have been absent.

Fall Web-Worm (**Hyphantria cunea Dru**).—Again abundant all over the Valley. Hymenopterous parasites were frequently noted in the webs.

Satin Moth (**Stilpnotia salicis L.**).—This insect, first located in the Province at Westminster in July, 1920, by officers of the Dominion Entomological Branch, has to be included in our list of shade tree depredators. Of European origin, introduced probably at least five years ago, this prolific insect was very conspicuous this summer in Vancouver and Westminster, and made a sorry mess of the poplars in these two towns.

Although little was known regarding its economic importance in its native habitat, its close relationship to the Gipsy and Brown Tail moths, Liparids like itself, singled it out for immediate attention by the Entomological Branch, and last year hopes were entertained and endeavours made to stamp out the outbreak in Westminster. Its discovery, however, in an area of larger extent in Vancouver, and also at Cowichan Bay on Vancouver Island, and at Maillardville near Westminster, showed the futility of entertaining these hopes with the funds likely to be available. We will, therefore, most probably have a permanent addition to our lepidopterous fauna, whether of great importance or not it is not possible to say at the present time.

It has so far been found chiefly on the Lombardy, White, and Black poplars in British Columbia, all introduced species, though also found sparingly on the native cottonwood, **Populus trichocarpa**; should it eventually accept this tree as readily as the introduced kinds which are its food plants in Europe, it would become a serious pest. As it is, it has caused considerable damage and annoyance, and has now spread over the whole area of Greater Vancouver wherever poplars have been planted.

FRUIT INSECTS

Previous reports recorded the following insects in varying degrees of destructiveness. These were noted as present this year, but in no cases were they serious:

The bud moth (**Tmetocera ocellana,** D. & S.)
The cherry and pear slug (**Caliroa cerasi,** L.)
The cigar case bearer (**Coleophora fletcherella, Fernald**).
The lesser apple worm (**Enarmonia prunivora,** Walsh).
The apple leaf hopper (**Empoasca mali,** Le Baron).
The oyster shell scale (**Lepidosaphes ulmi,** L.)
The pear leaf blister mite (**Eriophyes pyri Pgst**).

The apple dock sawfly or dock false worm (**Ametastegia glabrata Fallen),** mentioned as possibly present in the Valley in 1914 by Mr. Treherne, has now been found at Agassiz.

Small Fruit Insects

Strawberry Root Weevils (**Brachyrhinus ovatus and sulcatus**).—These caused much damage all over the small fruit areas. Several cases were reported of the second annual crop being a failure and the plantations being plowed up. A new species for British Columbia, **B. rugifrons,** was reared at Agassiz from larval material collected at Mission. From its apparent abundance, this pest, recognized in Washington and Oregon as of greater importance than **ovatus** or **sulcatus,** is possibly supplanting these species in the Lower Fraser Valley plantations. It was entirely absent in 1913, we may presume, as it is not reported by Mr. Treherne, who made exhaustive experiments on strawberry root weevils in the Mission district in 1912 and 1913.

The Currant Fruit Fly (**Epochra canadensis Loew**).—As usual, very troublesome in the Valley, spoiling much fruit. Some growers report being without it since the hard winter of 1915-1916.

The Gooseberry Sawfly (**Gymnonychus appendiculatus Hartig**).—More than usually abundant, and some cases of total stripping were seen. Much parasitized in the later generations.

The Tarnished Plant Bug (**Lygus pratensis L.**)—Common but not in epidemic numbers.

Hewitt's Leaf Roller (**Cacoecia hewittana Busck**).—Somewhat troublesome this year, especially on currants.

Imported Currant Borer (**Synanthedon tipuliformis L.**)—This insect is becoming more troublesome and is often the cause of sickly looking bushes. From its hidden manner of working it often escapes observation.

The Loganberry Crown Borer (**Bembecia marginata, Harris**).—This insect works freely on blackberry, raspberry and the wild thimble berry **(Rubus parviflorus),** but in no case does it cause so much trouble as on the loganberry, where it is a serious pest and one difficult to control.

The Raspberry Cane Maggot (**Phorbia rubivora,** Coquillet).—This insect is frequently seen in the raspberry plantations but not in serious quantity. Both this insect and the previous one, should they become more

numerous, would be a serious trouble to the small fruit grower and would present a difficult problem to the economic entomologist in their control. That this is more than a mere possibility is to be apprehended from the fact that they were only listed as suspects by Mr. Treherne in 1914, whereas they are now generally distributed and frequent. Their continued increase would give rise to the situation just mentioned.

Rose Scale (**Aulacaspis rosae,** Bouche).—This was met with occasionally on all cane fruits and roses, but chiefly on blackberries. It may be controlled by a lye wash in winter and by cutting out the badly affected canes. Only where neglected is any damage done.

Elm-Currant Aphis (**Schizoneura ulmi L.**)—This interesting species was collected at Chilliwack in the fall of 1920 by Mr. W. H. Robertson, Provincial Horticulturist. It is a double host aphid of European origin, alternating between the English elm **(Ulmus campestris)** and currants or gooseberries, but this is the first record of its occurrence on the currant in America.

Dr. Edith Patch, in Maine, and Mr. W. A. Ross, in Ontario, have found it rarely on elm.

In England it has been noted doing damage to young currant bushes in the nursery row, where it forms colonies on the roots after the style of the woolly aphis of the apple in its subterranean forms.

Beside the Chilliwack outbreak, bushes located at Agassiz were found to be infested, and I made this year some preliminary observations on its life history.

My first note is the finding of the stem mother with a numerous progeny in a typical leaf curl on English elms on the Experimental Farm at Agassiz. American elms are not touched by this species; the leaf curls on this latter tree being caused by "**lanigera**" or "**americana.**" The lice in these leaf curls produced winged migrants and were empty by June 20th, when on July the 5th, I found the commencement of the summer cycle on the black currant roots on the farm. These were situated at varying distances of from 50 to 200 yards from the elms. These apterous generations continued to increase and spread over the whole root system of the currants until September, when the winged form again appeared and returned to the elm for egg laying. This is an insect that will have to be watched, especially in its effect on nursery stock. In its present abundance it probably does but little damage to established plantations, but, should it increase, the problem of its control would be as difficult as that of the somewhat similar grape **phylloxera,** with the added difficulty that the returns from its small-fruit hosts do not admit of an expensive method of control being applied.

Experiments with soil insecticides carried on at Agassiz this year were not successful. Nicotine sulphate was the most promising, but failed to penetrate to the depths at which the lice were found.

When digging the young stock in the fall for distribution, the lice may be cleansed from the roots by dipping in nicotine sulphate without injurious effects.

Aphids in general were kept well in check this year by natural control, and many species of regular economic importance were a negligible quantity, as far as my observations went. The apple-grain aphis was in very small quantity on either host and was heavily parasitized all summer by a small hymenopteron. Coccinellids and Syrphids were abundant this year and kept all species in check effectually.

Amongst insects of general importance, several species of sawfly, especially on roses, were more than usually abundant, whilst the opposite extreme was attained by the Red-legged locust **(Melanoplus femur-rubrum)**, whose numbers were very small after a period of abundance for three years. It would be interesting and useful to know the exact causes of these fluctuations.

THE RELATION OF BOTANY TO ENTOMOLOGY

By W. B. Anderson, Victoria.

In offering you these few remarks, I do not purpose going deeply into my subject, nor have I made this paper too long. It is, in a way, a filler-up, as so many of our older members seem to have given up the writing of papers for these meetings, for the entertainment or the instruction of such of us as have had less time or fewer opportunities for systematic collecting. This is much to be deplored, for to the existence of this Society we are indebted to the zealous efforts of the older Provincial Systematists, and it is to be hoped that another year will see more of our old friends, and again hear from them of some of their delightful and entertaining experiences.

I have taken for title, "The Relation of Botany to Entomology," and propose to show, in so far as I am able, the value of a knowledge of Botany to the collector.

Among Economists, this is being demonstrated every day, in most cases quite unwittingly. As, for example, a searcher for the Codling Moth goes through apple orchards; for the Leaf Slug, among the cherries and pears. For the Vine Weevil among grapes, strawberries and primulas. So with other pests which harry the soul of the orchardist or the farmer. or gardener. But everyone knows the trees and plants just named, and the average Economist, were he to find any one of the pests enumerated on any other host plant but those he has been accustomed to associate with the particular insect, will be quite at sea, and unable to name the plant without collecting specimens and submitting them to someone of Botanical knowledge.

But when I say that, to be a really successful Entomologist, one should have a knowledge of Botany, I do not wish to give the impression that one must be a finished, scientific Botanist, for in Canada to-day these are nearly as rare as the Great Auk—, but merely that one should be so up in the rudiments of the science that he will be able to recognize, at least, members of the principal orders and their following genera. To the systematic collector this knowledge is particularly valuable, especially where the taking of the rarer species is concerned. Taking a certain section of our much varied Province, should one be keen on capturing certain species of Lepidoptera, Hymenoptera, Diptera or Coleoptera known to frequent the particular region one may be in, and one's time being limited, one loses no time, but searches primarily for a spot where grows the plant one knows to be attractive to the particular insect sought. Conditions of flowering, etc., being right, one is then fairly certain of a catch off the shrub or herb. To give a few examples:

The uncommon Geometer, **Marmopteryx marmorata,** may be taken only on the shrub called "False Grease Wood" or "Antelope Bush," **Kunzia tridentata.** It is simply waste of time looking for the insect elsewhere than on this shrub, or close to where it grows, and, should a stray specimen be taken on other vegetation, it is a surprise, while on its own particular shrub large numbers may be found in season.

Platea trilinearia, another rare and beautiful Geometer, is never found except on the "Sage Bush," **Artemisia tridentata.** Several of the rarer Blues seem to affect the mountain Lupines. The "Milkweed Butterfly" **Danais plexippus,** and its imitation, **Basilarchia archippus** must be looked for among the Milkweeds, **Asclepias.** Some years ago the country about Lillooet and other semi-dry belt areas were overwhelmed with what is ordinarily a rare Butterfly in the Province, **Aglais californica.** Apparently no damage was done to crops or other vegetation on the lower levels, but far up the mountain sides great areas of **Ceanothus sanguineus,** a white flowered shrub of the higher altitudes, were completely denuded of foliage by the larvae. After emergence, the insects seemed to drift gradually to the lower levels, where they finally numbered thousands. The following year this insect was conspicuous by its rarity.

Among the other orders this partiality to certain plants is perhaps stronger. Certain Coleoptera may be found only on "False Milkweed," **Apocynum sps,** others on certain of the Umbelliferae, others again on Composites, while many others feed entirely on certain Agarics and other Fungi. Gums of certain plants are highly attractive to many insects, these exudations being a sort of natural "sugaring," so largely practised by Old World collectors. Some of these natural sugars are evidently of more than prohibition strength, as many insects taken thus are quite incapable of action.

With these few remarks I shall close this paper. While possessing

a very limited knowledge of Botany myself, I have found that little of immense value in my collecting trips, and have often been puzzled by an attempted description of some plant on which other collectors have perchance taken rare specimens. Hence I have ventured to bring to the notice of this Society the value of some Botanical knowledge, so that we may remind ourselves that (excuse the paraphrase) "it is never too late to learn."

EFFECT OF FUMIGATION ON CERTAIN INSECTS

By W. H. Lyne, Vancouver, B. C.

The danger of nursery stock carrying objectionable insects from one country to another might be entirely overcome if the stock could survive the treatment necessary to destroy the insects.

Fortunately the San Jose Scale **(Aspidiotus perniciosus)**, is one of the species of insects hydrocyanic acid gas will kill without injury to the trees or shrubs exposed to the fumes. Provided, of course, the correct formula and exposure are used. This, of course, has reference to the ordinary application of the gas not applied under vacuum pressure.

It is, of course, understood that the San Jose Scale, being ovoviviparous, there are no eggs to contend with, simply the old or young insects, both of which are affected by the gas and so the extermination is complete; unless a very unique instance with which I happen to be familiar may be taken as an exception. On one occasion, after fumigating some apple trees infested with San Jose Scale, I examined a well developed female specimen with my hand lens and noticed a newly born specimen almost attached to the old one. Within half an hour an examination was made under the microscope and we were very much surprised to discover three newly born specimens all alive. The old female was apparently dead, but the young ones lived for several hours. There were several other specimens on the same tree, but all were dead after exposure to the gas.

Other species of Aspidiotus scale insects giving birth to living young include ostreaeformis and hederae, on which the hydrocyanic acid gas should be just as effective as with Aspidiotus perniciosus.

Egg-Producing Scale Insects

Aspidiotus ancylus and forbesi, Diaspis, Chionaspis, Mytilaspis and Lecanium, from which the young hatch from eggs deposited by the female, present another problem. The mother scale may be killed by the gas, but the eggs are liable to survive its effect.

Under the circumstances the only recourse is that of dipping the stock in a caustic solution, such as lime sulphur, whale oil, soap and nicotine or distillate oil emulsion. The hardy nature of the stock would suggest the best formula to use.

Were we to expose the stock to a cyanide or carbon bisulphide gas sufficient to kill all egg infestation, it would probably result in fatal injury to the stock as well as the egg.

The amount of injury to the stock would likely be according to the amount of moisture it contained.

Other interesting experiences we have had in connection with the fumigation of nursery stock has been with such insects as Browntail Moth larvae, Gipsy Moth egg clusters, Black, Woolly, Green and other aphis, Red Spider, Phylloxera, Narcissus Fly, etc. Also several species of root and stem borers.

That with Browntail Moth larvae, subjected to the usual formula of Hydrocyanic gas, resulted as follows:

Where the larvae remained undisturbed within their closely woven nest of silk web, the gas apparently had very little or no effect. In nests that were torn open, before exposure to the gas, some of the larvae appeared to be dead and others more or less seriously affected; they all appeared to be dead within about forty-eight hours.

GIPSY MOTH

In spite of fumigation, a cluster of Gipsy Moth eggs from France hatched out to a fine, robust colony of young larvae. They were not turned loose, however.

APHIS

Many of the adults of the different species of Aphis were killed by the gas, but the eggs survived. The adults of the Woolly Aphis **(Eriosoma lanigera)**, appeared to be the most resistant, and we have often been in doubt as to many of them ultimately surviving.

RED SPIDER

The adults of the red spider evidently were all killed, but the young spiders commenced hatching from the batches of eggs when exposed to the warm rays of the sun shortly after coming out of the fumigation chamber.

PHYLLOXERA

Adults of the grape phylloxera **(vastatrix)**, did not survive the cyanide fumes, but there was always a possibility of eggs being overlooked. For that reason any vines showing the phylloxera galls on the roots were discarded and burned, or returned to the shipper.

PEACH ROOT BORER

It would require a much stronger formula of hydrocyanic acid gas than is used for ordinary fumigation of nursery stock to kill the peach root borer **(Sanninoidea exitiosa)**, although many of the larvae extracted from their borings in the roots of peach, apricot, plum and cherry trees, appear sometimes to be seriously affected by the gas. On some occasions

they appear to be dead, but usually survive. This may perhaps be owing to some of the larvae being more securely embedded in the roots or crown of the tree than others, or some variation in the temperature and humidity within the fumigating chamber. Although 65° to 70° Fah. is the temperature usually maintained within the fumigating chamber, the humidity may vary owing to outside atmospheric conditions.

Blackberry Root Borer

The blackberry and raspberry root borer **(Bembecia marginata)**, is about as immune to the ordinary fumigating process as the peach root borer, and, to insure against distributing either of these pests, all the trees, bushes, vines and canes are thoroughly inspected. Any sign of the castings or borings of the insects condemns the tree, etc., to the bonfire.

Vacuum Fumigation

I have referred to the foregoing treatment of insects as applying to the ordinary fumigating process for the following reason:

We have great expectations regarding the vacuum process, by which we hope to get better results as regards the destruction of certain insect pests without injury to the stock or products they infest.

Vacuum fumigation is not entirely new in connection with the treatment of certain products, such as cotton, etc., but there are still a few problems that require working out to perfection regarding the treatment of certain nursery stock.

Mr. D. B. Mackie, of the California State Department of Agriculture, has already done excellent work solving the problems referred to. I could not do justice to his work were I to try and explain in detail all that he has accomplished. But we may look forward to a greatly improved method of nursery stock fumigation in the near future.

THE PEACH TWIG BORER, (Anarsia lineatella) IN BRITISH COLUMBIA

By R. C. Treherne, Entomological Branch, Ottawa.

In the years just preceding 1915 the peach growing industry of southern British Columbia was somewhat depressed. Prices had not been good and much disheartenment was in evidence. In 1915 the price for No. 1 wrapped peaches varied between 45 cents and 75 cents per 20 pounds. In 1916 the price varied between 60 cents and $1.00. In 1917 the peach industry showed signs of revival, the prices being received in this year varying from 75 cents to $1.25 to the grower. Much concern, however, was shown over the depredations of the Peach Twig Borer or Peach Worm, an insect which had been allowed to increase to such proportions in the

years previous to 1917 that, in that year, fully 50% of the fruit in the orchards was unmarketable, while a heavy loss was apparent with the fruit taken to the packing houses. Peaches, apricots, prunes and cherries were being attacked throughout the Okanagan Valley.

During the winter of 1917-1918 energetic steps were taken at the request of the growers by the Provincial Horticultural Department to institute repressive measures against this insect. A campaign of spraying was inaugurated in the spring of 1918, the measures taken being adapted from recommendations made by the States of Washington and California against this insect. During the course of the campaign of 1918 studies were begun by the writer, as an officer of the Dominion Entomological Branch, at Summerland, Penticton and Kaleden, and efforts were made to harmonize the developing life history of the insect with the spraying campaign then in progress. Similar studies were maintained during 1919. A short circular on this insect, its life history and control, was prepared by the writer and issued and circulated by the Provincial Department of Agriculture. This circular covered the essential features of practical value to the grower. So far as I am aware no effort has been made to present to entomologists the substance from which this circular was written. With this end in view, the following record is presented:

OVER-WINTERING HABITS

The adult of this insect is a minute moth which may be found on the wing in the orchards in considerable numbers during May and June and again in August and September. In a normal year two generations occur, the autumn brood of moths being present from early August until late September, ovipositing freely on the twigs. The eggs hatch, giving rise to larvae which over-winter. So far as our records go, the winter is only passed in this larval stage. Commencing in August and passing through September into October, these larvae, which are of an average length of 2.5 mm., after feeding to a slight extent on leaves, twigs and fruit, form hibernacula. This hibernaculum is a minute gallery made in the wood of the tree by the larvae. It is lined on the inside with silk and a minute column of frass is thrown up on the outside. These columns of frass are very distinctive and are readily seen, particularly when the castings are fresh. They occur in the crotches of 1, 2, 3 and 4-year-old wood of young orchards. When larvae are particularly numerous and in older orchards, these hibernacula are found, as well, in 5- and 6-year-old wood, on the underside of boughs as well as in the crotches. Entrance to the wood is frequently made through the stomata and in the softer cambium growth surrounding pruning scars. As a result of an examination of several hundred hibernacula during 1918 and 1919, in commercial peach and apricot orchards, by far the greatest number of larvae were found in the crotches of 1- and 2-year-old wood, usually on the upper sides and not underneath.

While the larvae enter their hibernacula in the autumn, 2 mm. to

3 mm. in length, they feed to some extent and undergo at least one moult before they emerge to continue their development. Signs of activity in the spring are evidenced by the production of fresh frass and by an enlargement of the gallery. These larvae may become 5.5 mm. in length before they emerge, although the average length is not more than 3 mm. in the spring.

There is a certain natural mortality of the larvae during winter. An exact record taken in unsprayed orchards in April, 1919, at Penticton, following the winter of 1918, showed that 31.5% of the larvae had died; 66.4% out of the 125 galleries examined in April, 1919, contained live larvae, while 2.1% contained dipterous larval parasites.

Spring Larval Habits

The over-wintering larvae, in the early spring, leave their burrows and move to the buds and blossoms. This migration commenced in 1918, on April 10th, at the time when the apricot and peach blossom buds were well swollen, and on April 21st, 1919, when apricots were nearly in full bloom and peaches were in the "pink." This migration, once started, was rapid. It was at its height on April 16th, in 1918, and on April 27th, in 1919; in the former year when apricots were in full bloom and in the latter year when the apricot petals were commencing to fall and peaches were in full bloom. Larvae were actually found infesting the buds of peaches on April 16th, in 1918, and on April 25th, in 1919. There is, however, as has already been pointed out, certain larval activity within the burrows previous to emergence. In 1919 this activity was apparent in the presence of fresh frass at the entrance of the burrows on April 9th, fully two weeks before any migration took place from the burrows. A period of cold, backward weather in the spring of 1919 checked the development which might have followed rapidly after the first appearance of activity.

Following the migration of the larvae from their over-wintering burrows, much feeding takes place at various points on the tree; buds and twig growth are fed on and mined, blossoms and young fruit are bored into and destroyed. At first there seems to be an inclination for the larvae to move freely over the tree, feeding here and there before settling in one fruit or twig. This is an important point which has its bearing on the value of arsenical sprays. This larval activity of the first generation continued until the middle of June, at which time practically all had pupated. In 1918, full grown larvae, measuring 12-15 mm. in length were found preparing to pupate on May 10th; in 1919 the first pupae were found on May 28th, though they commenced their preparation on May 23rd.

From these habits it may be seen that twig, leaf and fruit development are all attacked by the larvae in the spring and that there is a certain movement of the larvae over the tree, although they seldom move off the original twig on which they passed the winter. On the records

from the examination of a great many larvae during May, it was found that 83% of the larvae attacked twigs and 17% attacked fruit.

The injury to peach twig growth was more apparent than that on apricots. There was a slight wilting of the leaves in the initial attack, resembling the curl caused by aphids, followed by a distinctive withering and a darkening of the green color of the foliage, which becomes discernible by experience. With apricots the twigs grow faster and stronger than peaches and the wilting is offset, thus making determination of infestation difficult.

During June, twigs attacked in May recover and new growth forms to replace the wilted portions. Often a small cluster of dead leaves will be seen, particularly in apricots, with the new twig growth continuing without interruption. Sometimes where marked injury has been caused and the terminal bud destroyed, growth starts at other points on the stem. In a severe attack "twiggy" formation is a characteristic sign of previous infestation.

PUPATION OF FIRST GENERATION

Full grown larvae measuring 12 to 15 mm. in length were found on May 10th, 1919, preparing to pupate. A few days later pupae were formed. These were located, for the most part, in cracks and crevices of the bark in the main trunks and larger limbs. Beneath flakes of loose bark, within the characteristic curls of bark tissue and in the longitudinal cracks in the main trunk, were common locations, particularly on apricots. By the end of May it was almost impossible to find any larvae in the fruit or twigs, those found being full-grown, but pupae were plentiful. A few full-grown larvae were observed within the fruit of apricots on May 17th, but in general almost the entire generation were in the pupal stage by June 1st. In 1919 the first pupae observed were those bred under insectary conditions from larvae 3 to 4 mm. in length taken on May 2nd. These commenced to pupate on May 28th. Under field conditions in this year full-grown larvae were observed in the orchards on June 6th, but all had disappeared and had formed pupae on June 16th. The length of life of individual larvae varied from 38 days to 57 from the spring emergence from hibernacula, and the pupal period in each year lasted 14 days to 3 weeks.

EMERGENCE OF MIDSUMMER MOTHS

In 1918, the last week of May saw the first appearance of adults. Moths at Kaleden were seen on apricots on May 29th, and in the first two weeks of June they were common in the orchards at Penticton, and some were seen in the first week of July. In 1919 moths were observed on June 16th and remained common for a full month.

Eggs were seen, on occasion, shortly after the appearance of adults in each year, on new twig growth. Difficulties in rearing moths in cap-

tivity prevented the taking of more ample notes on the places chosen for oviposition, and the size of the egg precluded extended obsravtions in the field.

Appearance of Second Generation Larvae

In 1918 the first small larvae of the second generation were observed first, at Kaleden, on apricots on June 19th. The terminal leaf cluster was attacked much in the same way as the earlier spring damage was accomplished. In this same orchard larvae 4 mm. long were taken on June 27th. They had burrowed down two inches into the central pith of the stem and had caused the terminal growth to wilt. Other larvae, entering the stems at leaf axils, burrowed in, but frequently withdrew to attack the tips of the growing twigs, where surface tissue is fed on to some extent before entering and burrowing down the central pith, where they were commonly found. On July 10th, larvae 5 mm. in length were found, and on July 16th some 10 mm. long. In August larvae in all stages of growth, from 3 mm. to 12 mm., were common. Fruit was attacked much in the same way as formerly noticed, the larvae frequently gaining entrance near the stalk. Clustered peaches were often found attacked. Fruit thus entered would be completely hollowed out, showing a large cavity within and a minute entrance hole. The attack on mature fruit is probably the only really serious form of injury caused, as it renders it unmarketable.

In 1919 all larvae seen between June 6th and 16th were full grown. There was then a lapse of fully five weeks, in which period it was practically impossible to find any larvae of any kind and none at all on the particular trees which were under continuous and careful surveillance. On July 14 minute larvae 3 to 5 mm. in length were common. Hence field data supports our laboratory rearing that the larvae found during July and August arose from moths which had developed from overwintering larvae. On August 30th, in 1919, nearly all the larvae found in the orchards were full grown. During the first two weeks of September, minute larvae were again apparent, which, from our laboratory rearing notes, were the progeny from the autumn generation of moths. These small larvae formed hibernacula. The field notes of injury show no material variation in habits to that already evidenced by the spring larvae. It was noticed, however, that the percentage of larval injury to fruit was greater than the injury to twigs.

Second Generation and Moth Emergence

Collections of larvae taken between August 1st, and 27th, 1918, varied in size from 3 mm. to 10 mm. These were bred through under normal insectary conditions, using a small cage over a young peach tree. Pupation followed, and moth emergence took place between August 19th and October 1st. The height of the flight season occurred in the middle of August. The length of the pupal period again lasted about 14 days,

and 75% of the pupal cases were formed on the main trunk and crotches two feet from the soil surface. An unusual record was obtained from a pupa formed on July 13th, from a larva which had possibly been starved, and which formed its moth on July 21st.

In 1919 second generation larvae formed pupae on July 23rd, and moths emerged on August 4th. On August 5th, field observations showed 25% pupation; on August 19th 75%. Full-grown larvae were taken on September 4th. Moths were commonly observed in the orchards on August 19th and throughout the month. Laboratory material yielded moths until the close of September.

The second oviposition period of the year followed shortly after the appearance of moths, and eggs, although only seen at various times, must have been freely laid in both years, from the middle of August until October.

The larvae arising from these eggs enter the bark, form hibernacula and pass the winter with an average length of 2.5 mm., although some may be 4 mm. and a few as much as 5 mm. in length.

These young larvae undoubtedly feed to some extent before entering winter quarters, as they may be quite commonly seen feeding on mature peach fruit or on leaves during the latter part of August and in September. Hibernacula were formed and inhabited on August 20th and at all periods between this and autumn.

There is no doubt that two generations occur in a year, although it is true, in certain seasons, the second generation may not be quite complete.

THE CONTROL BY SPRAYING

The matter of control by lime sulphur and lead arsenate applications before and after blossoming have been laid down already in the circular previously mentioned. The following notes are supplementary to the circular:

On April 10th, 1918, at Kaleden, when the apricot buds were well swollen and purple, lime sulphur (1-9) spraying was in full operation. Triplex power machines with "gun" nozzles were employed, and certain sections of an orchard were personally thoroughly sprayed at 200 lbs. pressure, with particular spray direction into the crotches of the finer twigs, the work being done from the machine and not from the ground. On April 16th, and on succeeding days, it was found that a larger percentage of larvae survived than was expected. Some larvae were unquestionably destroyed in their burrows, for between April 10th and 16th the majority of the larvae in 1918 were still in winter quarters, though signs of activity were noticed in the presence of fresh frass and some larvae had migrated to the buds. Other larvae freshly destroyed were found in the terminal buds, indicating either that the solution penetrated

these burrows or that the lime sulphur had acted as a slow stomach poison following larval feeding on surface tissue. In the laboratory the value of lime sulphur as a stomach insecticide gave both positive and negative results. The caustic action would appear to be the main controlling factor, but it was not as great as anticipated, judging from the number of live larvae found a week after the applications in hibernacula and in buds. A careful record made in sprayed and unsprayed plots showed that no more than a 50% degree of control had been effected; a ratio from 8.1 to 3.8.

On May 9th, at Kaleden, when 60%-70% of the apricot husks had fallen and the fruit was three-quarters of an inch long, when the larvae were half to full-grown, an application of 2 gallons of concentrated lime sulphur to 100 gallons of water, to which was added 2½ lbs. of lead arsenate paste, the results proved that many larvae died from arsenical poisoning. Here, again, only 50% efficiency was apparent; a ratio being obtained of 7.2 to 4.5.

Owing to the extensive spraying campaign that was conducted in 1918, an opportunity offered itself to check the general results over a large acreage of peaches and apricots. The notes taken presented themselves without comparison to control blocks, hence are only judged on their relative commercial value, supported by observations of larvae in situ.

It was felt that both sprays individually applied did not accomplish more than 50% results, though the results obtained, supported by the natural larval mortality during winter and a certain natural loss in the pupae during May, were commercial and pronounced satisfactory. Those growers with extra zeal who applied two sprays, one before and the other after blossoming, obtained practically 100% results, for their orchards hardly yielded any worms at time of picking. This proved the desirability of making two sprays in heavy infestation, the practicability of rendering an orchard commercially clean in a single season, and lastly that moths do not move on the wing from one orchard to another to any appreciable extent.

In 1919, further notes on spraying were obtained. It was shown that a power machine, with a 200-gallon tank, actually carrying about 150 gallons, with a pressure of 250 lbs., using a "gun," one man and a driver, would spray two acres of 9-year-old apricots in bud to a filling. The trees were planted 170 to the acre, and about 15 trees were sprayed in 15 minutes.

A Pontiac machine, a favored lower powered machine, used for hillside work, carrying a 120 Imperial gallon tank, handled 5 acres of apricots a day during April. Two nozzle men and a driver were required, and 150-175 lbs. pressure was employed. Both machines did excellent work, the coating of lime sulphur being thorough.

Here, again, as in 1918, the hibernacula were not always penetrated. Some crotches containing hibernacula, encrusted with a heavy deposit of lime sulphur in the April spraying, yielded healthy larvae a week after application, but, on the whole, results were satisfactory. In this year, lead arsenate applications applied as soon after blossoming as possible gave better results than the lime sulphur sprays applied just before blossoming.

In consideration of the whole matter of spraying, growers have the choice of lime sulphur or lead arsenate, used separately or in association in two sprays, one just before and the other just after blossoming. In a heavy degree of attack, both applications may be made. The lime sulphur application has a slight preference over the later lead arsenate sprays owing to its possible effect against the fungous disease, "leaf curl." The spray for "leaf curl" is an early lime sulphur spray applied even before the buds break. A grower with a light attack of fungous and peach worm has the opportunity of economizing by combining this peach leaf curl spray with the spray for the peach worm.

FOREST ENTOMOLOGY

BY RALPH HOPPING.

If I were to ask you what was the most important crop of British Columbia, many of you would probably answer "apples" or "strawberries," for instance. The forests, however, produce the most valuable crop and turn in the most revenue to the Provincial Government. I understand the revenue is greater than all the other industries combined.

Although the Government is doing a great deal at the present time to preserve the forests, we are not properly or adequately taking care of this, the most valuable crop in the province; principally because the public does not realize that it is so valuable or so necessary, and we must have the support of the public when public money is expended.

The forests of B. C. have been subject to great losses from year to year, through two chief agencies: FIRE and DESTRUCTIVE INSECTS. Fire is the more spectacular, but the depredations of insects are at present of much greater importance in the open stands of yellow pine in the dry southern interior of the province. During the past eight years the loss from insects in and around Princeton and Merritt has amounted to over 200 million feet of lumber, worth at least 6 million dollars to the province.

The fires are being taken care of more and more effectively as the years go on by the protective force of the Forest Branch. Through close co-operation with this same Forest Branch, we are gradually beginning to take care of the insect depredations. This work, however, is a specialized department, as the insects attacking trees are of many species, each species of tree often having its own special group of insects.

The technique of the control measures employed to combat these depredations or epidemic infestations, as they are called, is supervised by a forest entomologist employed by the Entomological Branch of the Department of Agriculture.

The duties of a forest entomologist are many and varied. He must not only be able to tell in the field just what is killing a forest tree, and maintain as complete a collection as possible of all forest insects for identification purposes, but he must be able to recommend methods of control and to apply them in the field. In order to identify many of the tree killers in the bush, he must also be familiar with the different designs of the egg galleries.

Most of the insects killing forest trees are beetles. As many of the insects of all groups are injurious to the interests of mankind, we have little hesitation in killing them, nevertheless the methods employed are as painless as possible, in spite of the fact that many scientists insist that they have no sense of pain. I remember my daughter bringing a small boy just five years old into my study one time, where she showed him some of the brilliantly colored specimens and the boxes of beetles, both large and small. He was a very grave little fellow and looked at them without comment for some time. Finally he said, "Did you kill all of them?" "No," I replied, "but I killed a great many of them." I was astonished to hear him ask, "Oh, I suppose their souls are all in Heaven?" I do not remember what my reply was, but it probably was not satisfactory to myself or the child.

There is considerable loss due to the attacks of various bark-beetles in nearly all our British Columbia conifierous trees. For instance, bark-beetles kill each year many western white pines, **(Pinus monticola)**, and in some districts in the province have become epidemic and have killed the greater part of the white pine timber. Douglas fir **(Pseudotsuga taxifolia)** is subject to attack by the Douglas fir bark-beetle, and at least two such epidemic areas are now known to exist. Stands of true fir or balsam **(Abies)** are dying here and there from bark-beetle attacks. By far the greatest losses, however, occur in lodgepole **(Pinus contorta)** and yellow pine **(Pinus ponderosa)** and are mostly confined to the southern part of the interior.

The largest outbreak in lodgepole pine is in the Yahk district in the south-eastern part of the province, but various epidemic areas of greater or less magnitude occur between Penticton and Nelson and between Penticton and Princeton, and east of Okanagan Lake.

The losses in yellow pine have been much the most serious, owing not only to the greater commercial importance of this pine, but also to the virulence and long sustained attack of the bark-beetles causing the injury. The greatest outbreaks, in which the loss has been excessive, have occurred around Princeton, where it is estimated that 150 million board feet have been killed during the past six years, and in the Cold-

water Valley, near Merritt, where a very active infestation is now in progress. It is evident that the yellow pine in this whole forest between Princeton and Kamloops is threatened with ruin by these outbreaks, and that our control operations, now being conducted through the co-operation of the British Columbia Forest Branch, the Dominion Forestry Branch and the Dominion Entomological Branch, offer the only hope of saving it. Fortunately they promise to be successful.

There are three types of bark-beetle attack:

1. An endemic or so-called "normal" infestation exists in almost all forests, in which over-mature or weakened trees or their parts, are killed here and there from bark-beetle attacks.

2. Sporadic outbreaks frequently develop in the neighbourhood of slash, windfalls or light burns, particularly in bodies of weakened timber, but subside before many trees are killed.

3. Epidemic outbreaks resulting from a more serious disturbance of Nature's equilibrium, from either natural or artificial causes, spreading rapidly through the forest, killing great numbers of trees in a very short period.

An endemic infestation need cause little concern, although it effects considerable loss when this is computed over a period of years, and it is, of course, from this normal infestation that the serious outbreaks develop. The sporadic outbreaks, although small, may be important in stands of valuable timber, and may develop, if not controlled, into the more serious epidemic type. The epidemic outbreak is a serious matter, often killing 95% of the timber stand, in certain tree species, in the short period of five or six years. Control measures for epidemic outbreaks should be undertaken with the least possible delay, under the direction of a competent forest entomologist.

It appears probable that serious bark-beetle outbreaks usually develop through some notable disturbance of the natural conditions in the forest, such as windfalls over large areas where many trees are blown down, fires caused by lightning, or through human agency, such as carelesseness with fire, lumbering operations, or slashings of any description.

In windfalls and fires, we have conditions produced in which the bark-beetles are not hampered by the resistance of the healthy trees. The bark-beetles breed freely under these conditions and often start outbreaks as a result, immediately following the fire or heavy windstorm.

In logging operations we have a much more prevalent cause of epidemics. The immense amount of fresh slash, in the form of tops and cull logs, affords an ideal breeding ground for the destructive bark-beetles. The method of logging in the winter and not in the summer has been especially favourable to attack upon the standing timber. The beetles, completing their life-cycle in the freshly cut material, emerge,

and, having no new supply of cut material to enter, for they will not breed in dry logs, enter the living standing trees and kill them within one year. They then spread from year to year throughout the timber stand, leaving devastation in their wake. They also produce conditions favourable to the increase of other insects, usually considered as secondary, which, if they do not kill trees outright, nevertheless injure or kill parts of trees and assist the more important species in the general destruction.

The most important pine killing bark-beetles of British Columbia belong to two species of the genus **Dentroctonus**, of which one confines its attack to yellow pine, while the other attacks not only yellow pine but white pine and lodgepole pine as well.

In general, the method of attack is the same for both species. Emerging from a recently killed host tree in June or July, they attack other trees during July and August. Entrance tunnels are cut through the bark to the wood surface, and from the ends of these they excavate tunnels in the inner bark or between the bark and the wood surface, in which they lay their eggs in small niches cut along the sides. The larvae which hatch from the eggs also cut galleries more or less at right angles to the egg-tunnels and thus generally complete the killing of the tree by girdling it from top to base. Transformation to the pupal stage takes place either in the autumn or during April and May of the following spring, and the new brood of adult beetles emerges through exit-holes in the bark to attack fresh trees and thus extend the outbreak.

The number of insects a single tree can harbour is enormous. It has been estimated that in California a sugar pine 9 feet in diameter and 200 feet in height has produced one million beetles to spread to surrounding trees in the forest. Here in B. C. we have caged a yellow pine 24 inches in diameter and captured over 6000 of the killing species of beetle, over 16,000 insects of all kinds from the tree, over 10,000 of which were more or less injurious.

When these beetles emerge from a tree in July and August they immediately attack other trees. The emergence is not all in one day but spread over at least six weeks. By some instinct which they possess they are enabled to concentrate the attack on one particular tree. The first few hundred die by drowning in the pitch, but, as the attack goes on continuously from day to day, the resistance of the tree is weakened and it at last succumbs. If we have a late fall, many of the trees yellow before winter sets in, but, be the fall early or late, nearly all the trees so attacked yellow and die by the last of June of the following year. That is, trees attacked by September are dead the following June. It is therefore necessary in order to control an outbreak that the infested trees be cut and burned before the emergence in July and August. Our working period is from about April 1st to June 15th, as it is almost impossible to burn while the snow is on the ground.

An epidemic of one year, if not controlled, may increase 150 to 200% the next. Control work will decrease it at least 80%. If our forests were not disturbed, only large windfalls would increase these infestations to epidemic proportions, but promiscuous cuttings, unless regulated by the government, upset the natural balance and cause such outbreaks as we are having at the present time, which would answer the question, "Why is the Forest Entomologist"?

In conclusion, I wish to state that if a thorough campaign of slash disposal and control of incipient outbreaks is carried on in the future, the tremendous loss caused in the past to the forests of the province will not only be stopped, but much of the fire risk now caused by slash and dead standing timber will cease to exist.

MOSQUITO CONTROL AT BANFF

BY ERIC HEARLE, DOMINION ENTOMOLOGICAL BRANCH

In the Agricultural Gazette for May-June, 1922, the writer contributed a brief statement on an aerial survey of mosquito breeding places, conducted in the Lower Fraser Valley of British Columbia, which survey was made in 1921. In the same year, in company with Mr. Arthur Gibson, Dominion Entomologist, a brief survey was made of mosquito infested areas in the Rocky Mountains' National Park, adjacent to the town of Banff and the station of Lake Louise, Alberta.

It has been recognized for some time that relief from the mosquito trouble might be possible, and in the summer of 1916 the late Dr. Hewitt undertook a preliminary survey and drew up valuable recommendations. During the last three or four years a certain amount of control work has been conducted under Messrs. Sanson and Childe, of the Parks Branch, and considerable success was met within the reduction of the mosquitoes. In the Spring of 1922, Mr. Arthur Gibson, the Dominion Entomologist, arranged for a detailed investigation into the pest, and the writer was given charge of all the investigational and control work. Oiling operations were extended much further than previously, and as a result the mosquito pest in the vicinity of Banff was reduced to a negligible quantity during the past season.

The 1922 investigations showed that out of a mosquito fauna of some 18 species only three of the species were important pests.

Constituents of the Pest:

There were found to be two main problems—the snow-pool problem in the early summer and the flood water problem dependent upon the river freshets. In the former, one species only is important—**Aedes cataphylla Dyar**; but in the latter, while **Aedes cataphylla Dyar** is the species of main importance, **Aedes intrudens Dyar** and **Aedes vexans Meigen** have also to be reckoned with. In May the melting snows fill

depressions with water, and larvae of **Aedes cataphylla** are to be found in these pools in great numbers; the majority of these emerge during the last week of May and constitute the snow-pool pest.

The time of the river freshet varies—in 1922 it occurred in the first week of June. Mosquito larvae were found in vast numbers in the flooded areas, and most of those that escaped the oilers completed development before the end of the month. Collections of larvae carried out throughout the district showed that the low-lying area to the west and north of the town is mainly responsible for the pest. In some parts of this basin fairly extensive meadows occur, but dense willow growth clothes the remainder. The breeding areas appear to be of importance to some four miles west of the town.

During the past season oiling was mainly resorted to in dealing with the pest. Four men were employed through May and June to apply oil, and occasional extra help was provided as needed. Oiling occupied some 194 days' labour and about 2,800 gallons of oil were applied; watering cans and knapsack sprayers were utilized in spreading the oil. The whole breeding area was divided into three districts; one man being held responsible for the work in each. Large drums of oil were distributed by truck to various points in each district, and from these points the oil was transported in smaller containers to a number of stations in the breeding areas—a pack pony and a canvas boat were found useful for this. Oil was spread on all water where larvae were found, and, whenever oiling was completed in any one section, patrols were made to ascertain if effective killing had been secured. Coal oil was used alone, as, owing to the cold nights, it was thought inadvisable to use heavier oils.

A number of the breeding pools were undoubtedly missed owing to the difficult nature of the territory involved; and in some of the more open stretches wind rendered the oil film partially ineffective. In spite of this, however, the results of oiling were very marked, and about 77% control was realized—the town of Banff and the immediate vicinity were rendered comparatively free of mosquitoes.

After the necessity for oiling was over, the mosquito squad worked on permanent improvements. A number of ditches were dug to divert small streams feeding various swampy areas. In many parts of the district the willow growth was found to be so dense that penetration was extremely difficult and the work of oiling was greatly retarded; to mitigate this a large number of trails were cut through these areas and the majority were rendered easily accessible.

During the season of 1923 the Entomological Branch plan to continue investigations into the mosquito situation at Banff; flight experiments will be conducted to ascertain the actual distance from which infestation is possible; and it is hoped to secure data regarding the possibility of introducing certain natural control elements, such as the

minnows, which would materially reduce the costs of oiling operations. Experiments have also been projected to test out the comparative values of oils, larvicides, etc., and their adaptability to the needs of the district.

It is hoped that at the conclusion of these investigations mosquito control at Banff will have been placed on a fairly sound scientific basis, and that freedom from the mosquito nuisance will be possible with the greatest economy in labour and materials.

THE STATUS OF SPREADERS IN THE POISON SPRAY SOLUTION

BY A. L. LOVETT, ENTOMOLOGIST,
OREGON AGRICULTURAL EXPERIMENT STATION

Commercially prepared spreaders were used rather extensively in orchard spraying for the first time this past season. The interest manifested in this recent innovation in our spray practices makes it appear desirable to undertake a general survey of the situation, attempting to develop a summary of the opinions, observations, experiments and reactions of the growers, experimentors and others following the close of the year's trial of the use of spreaders.

HISTORICAL

The addition of materials to the spray solution for the improvement of its physical properties is by no means new. Various materials, including glue, molasses, soap, saponin, casein, gelatine, aluminum sulphate, etc., have been added as spreaders from time to time where the investigator, dealing with a specific pest or disease, appreciated the desirability of improving the wetting and adhering properties of the spray solution.

Probably the first large scale investigation of spreaders for use with poison sprays, having a rather definite application to the economic control of orchard pests, were those undertaken by the Oregon Experiment Station. A variety of materials were tested as spreaders; among the more promising were caseinate, glue, gelatine, saponin and mineral oil emulsions. In considering their qualities as a spreader, the following factors were necessarily taken into account: (1) Availability, (is the source of supply easily accessible and adequate?); (2) Compatibility, (the spreader must not react unfavorably with any ordinary spray water, spray material or combination of spray materials); (3) Efficacy, (in reasonable amounts they must actually give satisfactory results in increased wetting, adherence, etc.); (4) Ease in preparation, (complicated manipulations, cooking; any operation requiring close attention or much additional work meets little favor with the grower); (5) Cost, (must be reasonable in price).

With these factors as the standard of excellence, the caseinate spreader has appeared the most promising. Oil emulsions are a most worthy competitor, but there is a decided element of danger in their use under factors 2, compatibility, and 4, ease of preparation, as outlined above. If we could be sure the growers would appreciate the element of chance and use the necessary precautions in properly handling the oil emulsion, the ranking of these two materials as spreaders might possibly be changed, but in general the risk with oils is too great for their general adoption.

CASEIN SPREADER

In the tests at the Experiment Station and in the earlier field work, ordinary commercial ground casein, mixed with hydrated lime, was employed. In the earlier commercial orchard tests, while growers "mixed their own" casein spreader, not all reports were favorable. The process of mixing the spreader and its addition to the spray solution were of themselves subject to failure where any short cuts were attempted, also the casein available was variable in size of particles and in character.

With the opening of the season of 1921, some commercial companies began the manufacture of a prepared casein spreader. Of the powdered forms, which were by far in the majority, it may be said that in general they represented a high-grade casein, ground somewhat finer than the ordinary commercial product and thorougly mixed in definite proportions with hydrated lime.

These commercial materials combined to a very satisfactory degree the "essential factors" of a spreader. Particularly in the matter of ease of preparation were they popular, because it was possible to sift them directly into the spray tank, obviating any extra manipulations.

SPREADERS IN THE ARSENATE SPRAYS

The majority of the experimental work with spreaders at the station and in the majority of the cases of their use in the field, they were employed with poison spray solutions. The use of spreaders with the poison spray solution constitutes, therefore, the primary object of this enquiry. Summarizing our knowledge, it may be grouped under the following heads:

1. *Does the Addition of a Casein Spreader Increase the Efficiency of the Poison Spray in Apple-Worm Control?*

Earlier investigations under rather carefully conducted controls at the Oregon Station indicated a fairly marked increase in the percentage of control obtained where spreaders were added to the poison spray solution. During the past two seasons results have been more variable, and certainly less conclusively in favor of the spreaders.

Reports from California are conflicting, some feeling that decidedly better results are obtained, others finding little evidence of improved

control. DeOng, reporting on an arsenate foliage spray for red-humped caterpillars, reports superior control where casein spreader was employed.

In the Wenatchee section of Washington there is a general impression that spreaders improve the efficiency of the spray. In the Yakima section less spreaders have been used, and there is a general sentiment to the effect that spreaders do not improve the killing efficiency.

In the Twin Falls section of Idaho, spreaders were quite generally employed, and their use has received a most hearty endorsement from the growers. It would seem that they are enthusiastically united in the opinion that spreaders materially increased the killing efficiency. Where spreaders have been used in Oregon there is a general feeling that the control has been improved. However, recent investigational plats do not bear this out in any striking detail.

Summarized, we may say that while there is much evidence to indicate that the addition of a spreader to the poison spray solution increases its killing efficiency, it is decidedly doubtful as to just what extent this is true. It is our opinion that the value of a spreader in this regard will be, to a considerable extent, in proportion to the efficacy of the spray outfit; the excellence of the spray technique and the judgment in proper timing of the spray operation. Where any or all of these are faulty, the value of the spreader increases proportionately.

2. *Does the Spreader Improve the Spread of the Spray?*

All reports are agreed that with the addition of a spreader one obtains a smoother, less conspicuous and a more even distribution of the spray. This accomplishes two outstanding results of merit. The even, inconspicuous covering renders the fruit less likely to unfavorable suspicion regarding poison spray covering and makes wiping unnecessary in many instances. By avoiding the heavy blotchy covering of the fruit with the late summer spray, the red varieties of apple color up more evenly, improving the appearance and grade of the mature fruit materially.

This factor of a smooth, inconspicuous covering, thus avoiding the blotchy spray deposit and resultant uneven coloring, is really important, and to many growers serves as a good and sufficient reason for the enthusiastic adoption of spreaders in their late summer applications.

3. *Does the addition of a Spreader Increase the Covering Power of the Spray Solution so More Trees may be Covered per Tank of Spray?*

Some growers have checked on this point fairly carefully and are convinced that there is a material increase in the number of trees one may cover with a tank of spray where a spreader is added. Many have not checked on this, and a note of warning on the point is worthy of thoughtful consideration. It would be a most unfortunate situation if the grower, imbued with this idea of a quicker covering with less material, actually failed to use sufficient time or solution on the tree to

obtain the thorough spray covering required. So while it is conceivable that by increased wetting due to the spreader we would get quicker covering, this should not become a factor of first importance when deciding for or against the spreader.

4. *Are Spreaders Advisable with all Arsenical Applications?*

The consensus of opinion seems to be that spreaders should be used with all the lead arsenate applications from calyx or pink to the last cover spray. Considered strictly from a comparative point of view and valued on the beneficial results one might logically expect from its use in actual apple worm control, it would appear that the spreader in the solution could be dispensed with in the earlier applications if desired, but is of especial merit in the late cover spray.

Spreaders With Other Sprays

No careful experiments have been made at the Oregon Station with spreaders except with the poison sprays. Opportunities for observations on their use with other materials have been frequent, and other experimentors and growers have used them in a great variety of ways.

Fisher, of Washington, investigating the control of apple mildew with the application of lime-sulphur, developed a casein spreader for use and finds it a highly desirable addition. He also recommends it with the lime-sulphur spray for brown rot on prunes and cherries.

Jones, of California, finds the casein spreader a most satisfactory and practical substitute for glue in their lime-sulphur-oil-glue and their B.T.S.-oil-glue formulae in citrous spraying for scale in Tulare County.

Smith, of Idaho, considers the addition of the spreader decidedly improves the efficiency of the dormant spray of lime-sulphur for scale control and of lime-sulphur in the delayed dormant for red spider control.

DeOng, of California, considers the addition of casein spreader advantageous in red spider and aphis control sprays.

Wenatchee authorities of Washington feel that there is an improvement in most of their spray applications from the addition of a spreader. It was observed that in the lime-sulphur-arsenate of lead combination sprays, the addition of the casein spreader materially reduced the amount and retarded the development of sludge.

Where increased wetting, covering and adherence of the spray solution is desirable, the casein spreader improves. Bordeaux mixture is apparently improved to an equal degree with the other spray solution, though no careful experiments are at hand regarding the use of spreaders with the Bordeaux. One caution is apparently worthy of mention here —excessive amounts of spreader, i.e., more than one and one-half pounds of commercial caseinate to 200 gallons of Bordeaux solution may cause trouble; one pound is probably advisable.

WHAT ARE THE ADVERSE REPORTS ON CASEIN SPREADER

With a new substance introduced extensively for the first time, and tested under a great variety of circumstances, some adverse reports and serious criticisms are to be expected. Vague rumors and occasional reports coming in during the season led one to expect a rather definite and general unfavorable report upon some points. May I say that, everything considered, I am most agreeably surprised at the general and united favorable attitude on spreaders.

The one rather general complaint of the commercial casein spreaders is their cost. In this paper, I shall attempt neither to condone nor defend; I do hope it will be possible, as the business develops, for the commercial companies to decrease the cost of their product.

D. F. Fisher, Federal Pathologist of Wenatchee, has developed two modified casein formulae, and they were used rather extensively in the Wenatchee fruit section by growers this season. Two different methods have been used:

Water	1 gallon
Caustic soda	3 ounces
Casein	1 pound

The caustic soda is dissolved in the water while bringing to a boil, then the casein is slowly sifted in with careful stirring to avoid lumping. A little boiling will dissolve the casein, and this solution then forms the stock solution and may be used as a spreader at the rate of one pint to the 100 gallons, or the above amount is sufficient for 800 gallons of spray.

The second method is similar except that one employs baking soda instead of caustic soda, and the material does not need to be cooked. Probably a rather finely ground casein would be advantageous, and two gallons of water would avoid working with so thick a paste as otherwise. This stock must be used within reasonable time after its preparation because of the deterioration with a development of most unpleasant odors.

Summarizing our information on the casein spreaders, then, we may say that:

1. While there is considerable room for question as to the value of spreaders in increasing the toxic efficiency of the poison spray application where high-powered outfits are employed in the hands of experienced operators and the applications carefully timed, for the vast majority of growers the addition of spreaders is of advantage.

2. By increasing the evenness of the spray deposit, it is possible to obtain a more even coloring of the fruit, a point of more than passing importance. If it will avoid the necessity for wiping, as was the case with many growers this season, this likewise will prove a decided factor in favor of their more general adoption.

3. The addition of spreaders to other applications than the poison sprays seems equally desirable and effective in increasing their values under the same conditions.

It is our opinion that spreaders have come to stay. Undoubtedly improvements and modifications will take place as our knowledge and experience of spreaders increase.